DOCUMENT RESUME

ED 178 364 SE 029 375

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TITLE An Analysis of an Individualized Biology Laboratory in a Junior College.
INSTITUTION Clayton Junior Coll., Morrow, Ga.
PUB DATE 79
NOTE 10p.; Paper presented at the annual conference of the International Congress for Individualized Instruction (11th, Athens, GA, November 8, 1979)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Achievement; *Biology Instruction; College Science; Course Objectives; *Educational Research; *Individualized Instruction; *Junior Colleges; *Laboratories; Laboratory Experiments; Measurement

ABSTRACT

Reported is the analysis of an individualized biology laboratory program in order to determine if objectives of the laboratory were achieved by students and to identify factors related to success in an individualized laboratory. (Author/PB)

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ED178364

An Analysis of An Individualized Biology Laboratory in a Junior College

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The purpose of this study was to analyze an individualized biology laboratory with respect to achievement of laboratory objectives and factors related to success in the laboratory. The individualized laboratory is a required component of a two-quarter introductory biology sequence in a metropolitan area junior college. The lecture portion of the sequence is not individualized and from this students should gain knowledge of facts and principles of biology.

The individualized laboratory is open 28 hours per week. In the laboratory students should learn to apply the facts and principles of biology in a variety of investigative situations. Students sign-in and sign-out of the laboratory at their convenience; they may work alone or in groups for as long as needed to meet the objectives for a particular week. Objectives and detailed procedures are specified in the laboratory manual; more precise procedural guidelines are available in the audiovisual format (sound-slide and film loops). A detailed description of the purpose of this individualized laboratory has been reported (Lam, Halyard, and Walter, 1972).

The data for the analysis were gathered from 78 students enrolled in the second quarter of the two quarter sequence. A Method III: Measurement of

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Operations and Output model (Astin and Panos, 1971) was used for the analysis. Achievement of laboratory objectives was used as a measure of output. Educational operations were described by showing the influence on laboratory achievement of the following factors: time spent in lab, lecture achievement, ability to use the scientific method, age, college grade point average, total science hours, and SAT scores. These factors were selected because the literature indicates possible relationships between these factors and individualized methods of instruction (Fisher et al., 1977; Maccini, 1969; McClurg, 1971; Steffen, 1971).

Achievement of Laboratory Objectives

Achievement of laboratory objectives was determined by scores on objective-based laboratory examinations. Examinations included identification of materials from 2x2 color slides and photomicrographs, drawing conclusions from mock experiments similar to those in the laboratory, and explaining phenomena observed in the laboratory. Two laboratory examinations were administered during the quarter, each testing for different objectives. Each student's laboratory grade for the analysis was recorded as the sum of the points from the two separate tests. The mean laboratory grade (n=78) was 74.10 (100 point maximum) with a standard deviation of 12.23. This score indicated that the objectives of the laboratory are achieved by most students, although the large standard deviation is evidence of a heterogeneous population with respect to achievement in the laboratory. A frequency distribution of scores revealed that 79 percent of the students achieved at the 70 percent or higher level.

Factors Related to Success in the Laboratory

Stepwise multiple regression analysis was used to determine the relationship between success in the individualized laboratory and the following factors:

1. Lecture achievement (in total points) as a measure of knowledge of facts

and principles of biology,

2. Ability to use the scientific method, as measured by an in-house test (Halyard and Pridmore, 1979),
3. Time spent in the laboratory, as indicated on the sign-in and sign-out report sheets ,
4. Scholastic Aptitude Test scores (SAT),
5. Age of the student,
6. Total hours in science, and
7. College grade point average (GPA).

The BMD-02R computer program was used for the analysis. The data were gathered from 66 students for whom all information needed for the independent variables was available. A description of the sample with respect to independent and dependent variables is given in Table I.

Results of the multiple regression analysis are given in Table II. The data indicate that lecture achievement is the only significant predictor of success in the laboratory ($F=61.61$, $p < .01$) and accounted for 49 percent of the total variance in the laboratory grades.

Although neither age nor time spent in the laboratory was a significant predictor of success in the laboratory, the correlation matrix showed a significant correlation between age and time spent in the laboratory ($r=.31$, $p < .05$). The correlation matrix also revealed the following:

1. There is a significant negative correlation between age and the non-individualized lecture achievement ($r= -.27$, $p < .05$),
2. There is a significant correlation between the laboratory achievement and college grade point average ($r= .57$, $p < .05$).

The correlation matrix is given in Table III.

In separate regression analyses the Scholastic Aptitude Test (SAT) score

was included as an independent variable. The score was not found to be a significant predictor of time spent in the laboratory or of laboratory achievement.

Discussion

The results of this study indicate that 79 percent of the students achieved the laboratory objectives at the 70 percent or higher level. This indicates that the conditions in the individualized laboratory and the instructional strategies used were suitable for the majority of students. Multiple regression analysis revealed that lecture achievement, which is primarily a measure of knowledge of facts and principles, is the only predictor of success in the individualized laboratory. Because the laboratory is designed for students to apply the facts and principles of biology in investigative situations, it is reasonable that the high achievers would be students who have higher lecture grades and therefore a greater knowledge of facts and principles. The extra time available through individualization of the laboratory appears not to help weaker students, but instead to serve primarily as a convenience to students by providing for more flexible scheduling than would a non-individualized laboratory. This finding is consistent with the results of other researchers who found that college grade point average or course examination grades were significant predictors of success in individualized programs, whereas time spent in the laboratory was not (Maccini, 1969; McClurg, 1971). Other researchers have, however, found a definite correlation between achievement in audio-tutorial systems and time spent in the laboratory (Fisher and MacWhinney, 1976).

A significant correlation was found between age and time spent in the laboratory. It is interesting to note that age has no significant correlation

with laboratory achievement, however it was negatively correlated with non-individualized lecture achievement. This finding could indicate that the individualization is helping to overcome some of the older students' weakness due to lack of knowledge of facts and principles.

More direction in meaningful use of time in the laboratory would possibly help these students, as would verification of their knowledge of facts and principles before beginning the laboratory. Future plans include the use of weekly pretests of facts and principles needed for that particular laboratory and for knowledge of materials and procedures to be used in the laboratory. Knowledge of deficiencies should guide the weaker students in the use of their time in the laboratory.

In summary, the analysis of the individualized laboratory revealed the following:

1. Most students are achieving the laboratory objectives at the 70 percent level.
2. High achievers in the non-individualized lecture are also the high achievers in the individualized laboratory. The individualization serves therefore primarily as a convenience for most students.
3. Individualization possibly benefits the older student, as age is not negatively correlated to achievement in the individualized lab as it is in the non-individualized lecture.

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TABLE 1

DESCRIPTION OF THE SAMPLE WITH RESPECT TO THE VARIABLES USED IN THE MULTIPLE REGRESSION STUDY

VARIABLES	SCALE RANGE	MEAN	S.D.
LAB ACHIEVEMENT	0-100	74.44	12.84
LECTURE ACHIEVEMENT	0-100	75.09	9.90
LAB TIME	ACTUAL (MIN.)	106.30	24.06
COLLEGE GPA	0-4.00	2.39	0.54
AGE	ACTUAL (YEARS)	22.48	5.79
SCIENTIFIC METHOD	0-40	27.95	4.42
SCIENCE HOURS	ACTUAL (QUARTER)	10.38	3.08
SAT (TOTAL)	400-1600	838.23	168.56

NOTE: N=66

TABLE II

MULTIPLE CORRELATION OF LECTURE ACHIEVEMENT, TIME SPENT IN LAB, ABILITY TO USE THE SCIENTIFIC METHOD, AGE, AND TOTAL SCIENCE HOURS WITH LABORATORY ACHIEVEMENT

	MULTIPLE R	R^2	F
LECTURE ACHIEVEMENT	0.70	.49	61.61*
LAB TIME	0.70	.49	.63
SCIENTIFIC METHOD	0.71	.50	.46
COLLEGE GPA	0.71	.50	.46
AGE	0.71	.50	.14
SCIENCE HOURS	0.71	.50	.11

NOTE: N=66 *$F(1,64) = 7.04$, $p < .01$

TABLE III

INTERCORRELATIONS AMONG PREDICTOR AND DEPENDENT VARIABLES USED IN MULTIPLE REGRESSION ANALYSIS*

	SCIENTIFIC METHOD	SCIENCE HOURS	AGE	COLLEGE GPA	LAB TIME	LAB ACHIEVEMENT	LECTURE ACHIEVEMENT
SCIENTIFIC METHOD	---	.27	-.13	.29	-.13	.19	.36
SCIENCE HOURS		---	.02	.19	.15	.18	.25
AGE			---	.02	.31	-.18	-.27
COLLEGE GPA				---	-.15	.57	.76
LAB TIME					---	-.07	-.19
LAB ACHIEVEMENT						---	.70
LECTURE ACHIEVEMENT							---

*N=66. IF COEFFICIENT EQUALS .24 OR MORE, $p < .05$